WATER RESOURCES RESEARCH GRANT PROPOSAL

Project ID: 2005MT51B

Title: STUDENT FELLOWSHIP: Antibiotic resistance in ground-and surface-water microbes in the Missoula area

Project Type: Research

Focus Categories: Groundwater, Water Quality, Water Supply

Keywords: microbes, water supply, groundwater

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Non-Federal Matching Funds: $0

Congressional District: At Large

Principal Investigator:
Lewis Kogan

Abstract

Recent sampling of surface water and groundwater from Missoula area wells has revealed alarmingly high concentrations of a vast array of pharmaceutical products, ranging from Prozac and heart medicines to cold medicines and antibiotics (Woessner et al. unpublished observations). What is particularly disturbing is that, in a majority of the samples, antibiotics were at very significant concentrations. This leads to the question of whether these concentrations are sufficiently high enough to affect populations of surface and groundwater microbes. If they are, it naturally follows that these populations may be evolving to develop antibiotic resistance to whichever antibiotics are in inhibitory concentrations in the Missoula groundwater. The dangers of such evolution are not difficult to fathom. Already, several pathogenic bacterial strains are becoming resistant to multiple clinically-useful antibiotics, creating kinds of “super-bugs” that cannot be controlled through traditional antibiotic therapy. This presents the possibility of water-borne pathogens exhibiting resistance to a whole arsenal of pharmaceutical antibiotics. Also to be considered is the question of whether consumption of well- or commercial-water with antibiotics at these concentrations is presenting the antibiotics at constant low dosages to human and pet gastrointestinal tracts, allowing potentially harmful microorganisms in the body to adapt and develop resistance to these antibiotics. Thus, the

water we drink from our faucets every day may be contributing to this wide scale antibiotic resistance, an unexpected and alarming prospect. The question of the fate and effects of antibiotics in Missoula's surface and groundwater merits urgent and immediate study.

The objectives of our study are to determine whether surface water and groundwater microbes in the Missoula area are exhibiting antibiotic resistance at significant levels, and, if so, what concentrations of antibiotics seem to be necessary to trigger development of antibiotic resistance.

Methods of the study are as follows: First, to sample wells in the Missoula area for a complement of the most common antibiotics likely to be present in groundwater samples, and collect information on the presence and concentration of these drugs. Second, collect biomass from well-water samples and plate diluted biomass onto both selective and non-selective media to grow colonies. The non-selective plates will be used to screen the general culturable microbial population for the frequency of resistance to these compounds, while the selective media will better allow us to recover numerous examples of antibiotic resistant microbes for additional characterization, including specific identification of isolates by cloning techniques. Antibiotic-resistant microbes will be assayed for multiple antibiotic resistance and also compared to antibiotic-susceptible microbes and the concentrations of antibiotics in their well-water samples. All resistance experiments will be set against multiple controls.

Should we find that groundwater microbes ARE developing widespread resistance to antibiotics due to pharmaceutical contamination of groundwater, we will know that such contamination is a very pressing issue which needs to be immediately addressed. We should then look to determine where concentrations of antibiotics are highest in the Missoula area. What are the most likely contributors? What could be done to lower concentrations in groundwater enough to reduce selection for resistant microbes? We will have good information about prevalence of resistant microorganisms in wells with and without significant antibiotic concentrations, information on which microbes specifically have or are developing resistance, which microbes are resistant against which antibiotics, and the most common antibiotics microbes seem to become resistant to. If we do NOT find that groundwater microbes are developing resistance in the presence of antibiotic contamination, while it does not reduce the importance of the issue of pharmaceutical contamination of groundwater, we will know that the concentrations of antibiotic drugs found in the water samples is not high enough to be significantly inhibitory to microbes and cause selection for resistance. We will still have good information on which antibiotics are in highest concentrations in Missoula groundwater, and which are the most common contaminants, as well as data on which microbes seem to be most prevalent in the Missoula aquifer in sampled areas, and which microbes remain resistant to which antibiotics at constant exposure to specific antibiotic concentrations.